Office Use Only	
Project Code	
Project Type	

FINAL REPORT 2022

Applicants must read the *SAGIT Project Funding Guidelines* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be submitted by email to admin@sagit.com.au as a Microsoft Word document in the format shown **within two months** after the completion of the Project Term.

PROJECT CODE	H119
PROJECT TITLE	(10 words maximum)
Long-term cropping systems trial	

PROJECT DURATION *These dates **must** be the same as those stated in the Funding Agreement.*			
Project start date	**1/07/2019**		
Project end date	**30/06/2022**		
SAGIT Funding	**(year)**	**(year)**	**(year)**

PROJECT SUPERVISOR CONTACT DETAILS *(responsible for the overall project)*			
Title:	**First Name:**	**Surname:**	
Miss	Rebekah	Allen	
Organisation:	**Hart Field-Site Group**		
ACN / ABN:			
Mailing address:			
Telephone:		**Email:**	
Mobile:			

PROJECT REPORT: *Please provide a clear description for each of the following:*

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs.

- Across 21 years, no specific seeder type (no-till, strategic or disc) or nutrition regime has given a consistently higher yield each season.
- Soil measurements including water infiltration and soil bulk density were not affected as a result of seeder type.
- Results of this project show that the decision-making behind growers selecting a seeder type can be influenced by factors affecting their crop management, including; plant establishment, pests and weeds, sowing speed, stubble management, soil type and herbicide residue. This result is reflected across the southern region, where a large variation of seeding and crop management strategies now exists.

Project objectives

A concise statement of the aims of the project in outcome terms should be provided.

During this project, the long-term effects of contrasting cropping systems and nitrogen fertiliser inputs were investigated, while overall maintaining one of the few long-term cropping systems trials remaining in the Southern region from 2000 – 2021 (21 years of data).

Overall Performance

A concise statement indicating the extent to which the project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

Across the duration of this trial, project objectives were achieved; including coordinating and sowing of the trial, conducting soil and crop assessments and communicating written trial results. Hart research personnel involved in this project include; Rebekah Allen; R&E Manager, Sarah Noack; former R&E Manager, Declan Anderson; Hart Intern and Brianna Guidera; former Hart intern. Local growers involved, supplying seeding equipment include; Matt Dare (no-till seeder treatment + commercial crop manager), Michael Jaeschke (strategic seeder treatment) and Tom Robinson (disc seeder treatment). Technical staff from SARDI Clare also assisted with some trial maintenance. Despite all efforts from Hart staff, difficulties were experienced in 2021 coordinating the seeding of the disc seeder treatment. Seeding of this treatment was conducted almost one month after the no-till and strategic seeder. As a result, harvest data from 2021 was not analysed due to late seeding influencing results.

KEY PERFORMANCE INDICATORS (KPI)

*Please indicate whether KPIs were achieved. The KPIs **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	Achieved	If not achieved, please state reason.
Trial planned; three different seeders coordinated to sow the trial.	Yes ☒ No ☐	
Soil and plant assessments performed, trial harvested and all results analysed.	Yes ☒ No ☐	
Trial results written up for communication and widely publicised.	Yes ☒ No ☐	

Field extension – a number of growers and/or industry have utilised the trial / findings each season	Yes ☒ No ☐	

TECHNICAL INFORMATION (Not to exceed **three** pages)
Provide sufficient data and short clear statements of outcomes.

The performance of crop grain yield (t/ha) was not significantly improved by any seeding system (disc, no-till or strategic). In years when yield differences were observed, the no-till and disc system either standalone or equally outperformed the strategic treatment.

In the nine years where grain yield differences were observed, approximately 60% of years had below average growing season rainfall (>300 mm). During this project, there was a lack of consistency across years where yield gains were observed, meaning that yield gains are unlikely attributed to seeding system performance under varying growing season conditions (Table 1).

		Strategic		No-till		Disc		LSD (P≤0.05)		
Year	Crop	Medium	High	Medium	High	Medium	High	seeder	nutrition	seeder × nutrition
2000	Barley	3.8	3.8	3.7	3.8	3.7	3.9			
2001	Canola	1.3	1.6	1.4	1.7	1.3	1.8	ns	0.1	ns
2002	Wheat	0.9	0.7	0.9	0.8	0.7	0.6	ns	ns	ns
2003	Wheat	2.8	2.6	3.0	3.0	3.1	3.2	0.3	ns	ns
2004	Barley	2.3	2.0	2.1	2.1	2.0	1.7	ns	n	0.3
2005	Field pea	2.5	2.6	2.4	2.3	2.1	2.1	0.2	ns	ns
2006	Durum	0.1	0.1	0.2	0.2	0.1	0.1	ns	ns	ns
2007	Wheat	1.9	2.2	2.3	2.1	2.3	2.4	ns	ns	ns
2008	Wheat	1.1	0.8	1.3	1.2	1.5	1.4	0.2	ns	ns
2009	Barley	4.3		4.2		4.2		ns	ns	ns
2010	Canola	1.2	1.9	1.5	2.0	1.6	1.9	ns	ns	0.3
2011	Wheat	2.3	2.2	2.5	2.5	1.7	1.8	0.2	ns	ns
2012	Field pea	0.9	0.9	1.1	1.1	1.1	1.0	0.1	ns	ns
2013	Wheat	-	-	5.0	5.0	5.2	4.8	ns	ns	ns
2014	Barley	4.4	3.9	4.7	4.0	4.5	4.0	ns	0.2	ns
2015	Canola	0.6	0.6	0.6	0.5	0.5	0.5	ns	ns	ns
2016	Wheat	4.8	5.9	4.2	5.8	5.0	5.9	ns	ns	0.3
2017	Wheat	3.5	3.3	3.5	3.5	4.1	4.1	0.2	ns	ns
2018	Field pea	0.8	0.7	0.9	1.0	0.7	0.7	0.2	ns	ns
2019	Wheat	1.3	1.2	0.9	1.1	1.3	1.3	0.2	ns	ns
2020	Wheat	2.6	2.7	2.3	2.4	3.0	3.0	0.2	ns	ns

Table 1. Grain yield (t/ha) for seeding systems and nutrient treatments from 2000-2020. Medium nutrition treatments (Medium) represent standard practice for the district based on Yield Prophet® and general rules of thumb. High nutrition (High) treatment represents standard district practice plus an additional nitrogen application in season (generally an additional 20-50 kg N/ha). Grain yield data from 2021 was not analysed.

Overall, seeding systems had little impact on starting available soil nitrogen prior to each season, with disc and no-till treatments producing similar results over the life of this trial. Across 21 years of sampling, a small proportion (20%) of seasons, have shown that the strategic treatment had higher available nitrogen pre-seeding.

The surface placement (e.g., no-till and disc) of stubble results in slower decomposition rates compared to the strategic treatment, which is often cultivated pre-seeding or prickled chained, incorporating stubble into the topsoil. Over the last 8 years of this project, the strategic treatment

turned into a one pass system, no longer including pre-seeding cultivation, or post seeding chaining, however; greater soil surface and stubble disturbance was present.

Soil organic carbon (SOC%) levels were measured in 2007, 2014 and 2021. In each season that SOC% was measured, no differences were observed between the disc, strategic and no-till seeder treatments, however; soil organic carbon levels were significantly higher ($P<0.002$) in 2014 (1.92%) when compared to 2007 and 2021 (1.72 and 1.63% respectively). Observed differences are likely to be a result of 2014 having greater soil available N, potentially increasing organically bound carbon. In comparison, data collected from the native vegetation area at the Hart field site in 2014 contained 5.20% SOC (data not shown).

In 2021, water infiltration for each seeding system was assessed using a double ring infiltrometer (one year of data only). Measurements were recorded every 2 minutes until a constant infiltration rate was achieved. No differences were observed for water infiltration between seeder types (100 – 110 mm/hr) despite differences in soil disturbance from the tillage systems

Although previous research has shown that no-till and disc seeding systems tend to have increased bulk densities due to less soil disturbance (Grant & Lafond 1993), results at Hart in 2021 showed that the different seeding systems did not affect soil bulk density (one year of data only). Moving from a two to one pass system in 2013 may have removed some treatment effects that could otherwise be observed in a true strategic system.

A gross margin analysis from 2014 and 2015 displayed similar returns for each seeder. In most years, the disc seeder had the greatest return of up to an additional $77/ha per year, with strategic and no-till treatments showing a similar return. Similarities between these two seeders were attributed to the strategic treatment moving to a one-pass system.

In 2017, 2019, and 2020 the disc treatment had higher yields, correlating to higher gross margin returns. The return on nitrogen fertiliser inputs was similar across many years, with either small or no gains ($/ha) for high N treatments across disc, no-till and strategic seeder treatments. The medium input treatment performed well across most years, excluding 2016 in a well above average growing season (decile 8), providing a greater average return of $23/ha across the six-year period.

CONCLUSIONS REACHED &/OR DISCOVERIES MADE (Not to exceed one page)
Please provide concise statement of any conclusions reached &/or discoveries made.

A summary of conclusions:

- Across 22 years, no specific seeder type (no-till, strategic or disc) or nutrition regime has given a consistently higher yield each season.
- In the later years of this project, water infiltration and soil bulk density were not affected as a result of seeder type and it was observed that these treatments also had a similar starting available soil nitrogen prior to each season. Soil carbon was also consistent between seeder treatments and only varied as a response to the previous crop rotation.
- The overall results of this project means that the decision-making behind growers selecting a seeder type can be influenced by factors affecting crop management, including; plant establishment, pests and weeds, sowing speed, stubble management, soil type and herbicide residue. This result is reflected across the southern region, where a large variation of seeding and crop management strategies now exists.

INTELLECTUAL PROPERTY

Please provide concise statement of any intellectual property generated and potential for commercialisation.

N/A

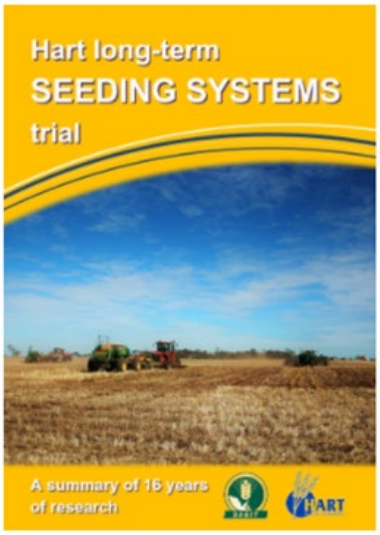
APPLICATION / COMMUNICATION OF RESULTS

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

Long term extension from the trial



- One of the main products from this trial was the development and release of the "Seeding systems trial: A summary of 16 years of research" booklet (pictured). Since the book was released in September 2016, we have distributed 200 hardcopies and an additional 1,500+ copies have been downloaded from the HFSG website to date (including more than 359 downloads in the past 12 months).
- A revised second edition has been completed and will be released on September 20, 2022; coinciding with the 40th annual Hart Field Day Event. An electronic version will be made available online for free: Hart Field Site Group - Grower Guides.
- New additions to the booklet include:
  - Updated yield and grain quality results from 2016 – 2021
  - New and updated soil measurements (SOC%, Water infiltration, nitrogen, carbon and bulk density)
  - A revised addition to Hart's grower case studies; Where are they now?
  - Second partial gross margin (2014 – 2020)
- Prior to release, an electronic copy can be provided to SAGIT on request.

In addition to the long-term cropping systems booklet, Hart has written and released annual trial results, published in Hart's annual trial results book (Hart Field Site Group - Trials & Results). Each year, the trial was fully signed in-season and open to view at events and by groups who visited the site, including University of Adelaide students, SARDI group visits, local grower access and advisor groups.

POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

Although this long running trial has provided great value to growers since 2000, after a large focus on direct drill air seeders (a one pass system), the decision-making behind growers now choosing a seeder type is heavily influenced by various factors. A decision made by both the Hart board and research committee after reviewing trial results/conclusions, was that further funding for the long-term cropping systems project would not be sought. We thank SAGIT for their support of this project over many years.